भारतीय मानक
Indian Standard

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यात्री रोपवे में उपयोग के लिये लोहा और इस्पात के वर्गो की जंग से सुरक्षा — रीति संहिता

Corrosion Protection of Iron and Steel Sections Used in Passenger Ropeways — Code of Practice

ICS 45.100

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Continuous Bulk Conveying, Elevating, Hoisting, Aerial Ropeways and Related Equipment Sectional Committee, MED 06

FOREWORD

This Indian standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Continuous Bulk Conveying, Elevating, Hoisting, Aerial Ropeways and Related Equipment Sectional Committee, had been approved by the Mechanical Engineering Divisional Council.

An aerial ropeway is a special form of transportation system where passengers/materials are carried on a tensioned wire rope supported above the ground. In ropeways handling passengers, safety, reliability, and conformance to high-quality and good industry practices are paramount for securing the safety of the users. Aerial ropeways are particularly useful in regions where the facility in surmounting natural barriers gives them a great advantage over railways or roads, both of which may need the heavy civil engineering work to secure easy gradient. They are inexpensive to maintain, pollution free, environment friendly, does not affect aesthetics, their power demand is modest and, are not seriously affected by adverse climatic conditions.

Nothing in this standard is intended to contravene any provisions of the statutory regulations wherever they are in force.

Composition of the Panel-1 on ‘Aerial Ropeways’ of MED 06 responsible for the formulation of this standard is given at Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*) . The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CORROSION PROTECTION OF IRON AND STEEL SECTIONS USED IN PASSENGER ROPEWAYS — CODE OF PRACTICE

1 SCOPE

This standard covers the general principles of corrosion and its prevention for the iron and steel structure/components used in passenger ropeway installation.

2 TERMINOLOGY

For the purpose of this standard, the definitions given in IS3531and IS 1303shall apply.

3 MECHANISM OF CORROSION

Iron and steel corrode in presence of moisture. The nature of this corrosion is electrochemical. At certain spots, known as ‘anodic points’, iron enters the electrolyte as ‘ions’ and causes ‘anodic reaction’. Since the passage ions into the electrolyte leaves electron behind, it may continue only if elsewhere a ‘cathodic reaction’ has been established to use up electrons. A corrosion cell is thus set up. The flow of current in the corrosion cell thus formed results in attack on the metal at the anode, but the cathode is not corroded.

4 FACTORS GOVERNING THE CORROSION RATE

The severity of corrosion is controlled by a number of determining factors, such as condensation, moisture, atmospheric pollution (both industrial and marine), deposition of solid particles and surface condition of metals.

4.1 Effect of Condensation and Moisture

At atmospheric temperatures, the metals used in engineering are generally resistant to direct oxidation and suffer rapid attack only when electrochemical action takes place. Usually an electrolyte is provided by a film or pocket of condensed moisture on metal surface or by wetting due to exposure to rain. It may also be provided by absorption of moisture from the atmosphere by hygroscopic substance like dust or other contaminants deposited on metal surface.

4.2 Atmospheric Pollution

Corrosion is greatly stimulated when the air contains sulphur dioxide and corrosive salts, such as certain sulphates and chlorides. The main sources of those types of atmospheric pollution are the combustion of coal and other fuels, exhaust gases of automobile and marine spray.

4.3 Effect of Different Climates

The corrosion rate is profoundly affected by the microclimate and to a lesser degree by the mass, size and shape of the metal, and by angle of exposure.

4.4 Effect of Location of Exposure

Corrosion rate of a metal also varies with the location where the structures are erected. The proximity to source of pollution also plays a vital role.

4.5 Effect of Orientation of Exposure

The orientation of metal specimens influences the corrosion rates due to its effect on the amount of moisture or atmospheric contaminants that can react with the surface.

4.6 Effect of Metal Composition

The type of chemical composition of ferrous metals have a marked influence on their resistance to atmospheric corrosion.

4.7 Surface Condition

4.7.1 *Mill Scale*

Structural steel plates and section produced by hot-rolling are covered with a thin blue-black or reddish-blue layer of iron oxides. It generally cracks and flakes appreciably while the steel is cooling down after rolling end is liable to spall from the metal during fabrication and subsequent exposure.

4.7.2 *Casting Skin*

The casting skin on cast iron results from the reaction of the siliceousmould lining with the hot metal. It is more adherent than mill scale and is often protective.

5 GENERAL REQUIREMENTS OF CORROSION PREVENTATION

5.1 The guiding principles to be followed for the protection against corrosion are given in **5.2** to **5.4**

5.2 All steel parts shall receive, before they leave the fabricating works, an adequate protective treatment. The selection of the treatment would depend on the atmospheric conditions prevailing at the site of fabrication, transport and erection.

5.3 Steps shall be taken at all stages in storage, transit and erection to avoid damage to the protective coatings. When adequate precautions cannot be taken to prevent damage, protective schemes should be selected so that local damage will not lead to general failure of the coating.

5.4 The best procedure is to apply the protective scheme to the finished part, that is, after drilling, bending and welding processes have been completed. Overlapping surfaces occurring at bolted/riveted joints are best protected before they are assembled. Special care is necessary when applying certain chemical processes to parts of intricate shape to avoid entrapping processing solutions in the crevices.

6 METHOD OF CORROSION PREVENTION

Preventive measures generally needed fall into three main groups namely:

a) Treatment of the environment;
b) Protective coatings; and
c) Cathodic protection.

6.1 Treatment of the Environment

Remedial measures include lagging the steel, space heating and the installation of air conditioning system to reduce relative humidity and atmospheric pollution.

6.2 Protective Coatings

The essential of a protective scheme are proper surface preparation prior to coating coupled with impermeability and adequate thickness of the coating. They are grouped into two categories:

a) Metal coating (*see* 9), and
b) Paint coating (*see*10).

7 SURFACE PREPARATION AND PRETREATMENT

7.1 Pretreatment and priming of ferrous metals under controlled conditions of the factory gives the best results and it is therefore advisable to adopt this method whenever possible. The object of such treatment is to preserve and protect the metal surface during transport, storage and erection and minimize the ‘on site’ preparation for final painting. Much will depend upon the time between the factory treatment and erection, the care with which the materials have been stored and handled during that period and the protective quality of treatment applied.

7.1.1 *Factory Pretreatment*

7.1.1.1 *Removal of oil, grease, dirt and swarf*

Generally, the application of any coating, lining material, adhesive or paint requires as its first essential and perfectly clean surface, which is of very great importance while dealing with the painting of ferrous metals. It is, therefore, essential prior to the application of any paint that even theminute trace of grease and oil are removed. Grease removal shall be carried out either with solvent type or alkali type degreasing agents.

7.1.1.2 *Removal of rust and scale*

De-rusting and de-scaling are the essential preparations required prior to the application of any type of coating on iron and steel. It may be carried out by any of the following means:

a) Mechanical cleaning by scraping, chipping, wire-brushing, rubbing with abrasive paper or steel wool, by flame cleaning or by sandblasting or shot blasting.
b) Chemical cleaning (pickling) by sulphuric acid, hydrochloric acid or phosphoric acid pickling.

7.1.2 *On-site Pretreatment*

7.1.2.1 *Surface untreated or protected with a temporary protective*

These are dealt with at site as follows:

a) Temporary protective materials applied to steel sheets to protect during storage, transport and creation should be removed with suitable solvent as a preliminary to other preparatory treatments.
b) The use of abrasive paper wetted with suitable solvent, is effective in removing the worst effects of lubricants.
c) Surface which are protected with a temporary protective may be steam cleaned.

8 RECOMMENDED PROTECTIVE SCHEMES FOR GENERAL STRUCTURES

8.1 Basis of Recommendation

When selecting the appropriate grade of protection attention should be given to the severity of the exposure conditions, nature of the structure, its utility, expected life and maintenance schedule. The recommendations made in Table 1 for the protection of steel work used outdoors are based on the results reported from the outdoor exposure tests carried out at various centres in India and also on experience of the protective scheme gained both by research and by observations of their behaviour in service.

8.1.1 On the basis of the relative corrosive of outdoor atmospheres in various parts of India, the different regions may be broadly classified into the following categories:

Very high	Above 0.23 mm / yr
High	0.13 – 0.25 mm / yr
Moderate	0.05 – 0.13 mm / yr
Low	0.025 – 0.05 mm / yr
Very low	Below 0.024 mm / yr

8.2 Protective Scheme

Taking into consideration the various factors, broadly three different grades of protective schemes have been suggested in Table 1 for areas with different corrosivities. They represent the minimum acceptable standard of good practice and should prove economical in maintenance. Each protective scheme consists of a metal coating or a method of preparing the steel surface, followed by a paint system, sometimes after an intervening pretreatment. Individual components of each system may be obtained from Table 1.

8.2.1 *Grade A Scheme*

This consists of an initial protective scheme applied to last for a period of 5 years or more with repainting period varying between 5 and 8 years and above depending on the environment.

8.2.2 *Grade B Scheme*

This consists of an initial coating to last for a minimum period of 3 years, with repainting schedule varying between 3 and 5 years.

Table 1 Recommended Protective Schemes to Be Used Under Different Corrosive Conditions

(*Clauses* 8.1 and 8.2)

Component of Protective Scheme			Intensity of corrosion				
			Less than 0.025 mm per yr,	0.025-0.05 mm per yr,	0.05-0.12 mm per yr,	0.12-0.25 mm per yr,	More than 0.25 mm per yr,
Surface preparation	Hand cleaning		■●	■●	⊙		
	Flame cleaning		◆	◆	◆■●	●	
	Pickling					□	□
	Sand or grit blasting					◆■	◆■
Metalic coating	Aluminium	0.07-0.12 mm thick					◆
		0.02-0.07 mm thick				◆	■
	Zinc	0.07-0.12 mm thick					▯
		0.02-0.07 mm thick				▯	□
Primer paint coating	Zinc chromate	Single coat	◆■	◆■	●		■
		Double coat	□	□	□	◆	◆
	Red lead	Single coat	□	▯	⊙		
		Double coat			◆■	■●	
Finishing paint coating	Aluminium pigmented	Single coat	■	■			
		Double coat	◆	◆●	▯■●	◆■	◆■
	Synthetic enamel	Single coat	□	□			
		Double coat	▯	▯⊙	◆⊙□	□▯●	

◆	Grade – A scheme	■	Grade – B scheme	●	Grade – C scheme
▯	Alternative	□	Alternative	⊙	Alternative

8.2.3 *Grade C Scheme*

This consists of a coating system which requires renewal every year or every alternate year.

9 METAL COATINGS

9.1 Metal coatings, when used in combination with suitable paint systems, prevent the onset of rusting in severely corrosive conditions where paint alone gives protection only for a limited (short) period. Therefore, they are particularly valuable where it is essential that rusting should not take place, or where the intervals between maintenance are protected. They are also effective in chemical atmospheres, provided proper metallic coating is chosen.

9.1.1 For steel work the choice generally lies between hot-dip galvanizing, sprayed zinc and sprayed aluminium. If a zinc coating is to be used alone, hot-dip galvanizing should be generally preferred, because of the smoothness and freedom from porosity of this type of coating.For recommended procedure, refer respective Indian Standard listed in Annex A

9.1.2 Aluminium coatings are useful for protecting steel in severe service conditions at high temperatures and from a good basis for heat resisting paints. Aluminium coatings need protection against alkaline exposure conditions. For recommended procedure, refer respective Indian Standard listed in Annex A

9.2 Metal coatings need not be painted, provided they are thick enough to withstand the service conditions for the desired life of the structures.

10 PAINT COATINGS

10.1 Priming Paints

Ordinary red-oxide may be dependent upon only for inland dry places like Delhi. Zinc chromate/red-oxide and barium chromate should be used in areas where humid tropical conditions are obtained.

10.1.1 *Red Lead Primer*

It is specially useful when paint has to be applied to imperfectly prepared surfaces, carrying broken mill scale and rust, which result from weathering and hand cleaning.

10.1.2 *Zinc Chromate Primer*

It is specially suitable for priming light alloys used in the aircraft industry, but is generally used for the protection of light alloys as well as steel work.

10.1.3 *Zinc Rich Primer*

The metallic zinc pigment in these primers should be bound in a medium of epoxide resin, chlorinated rubber or polystyrene, so as to yield a paint suitable in all respects for brush application.

10.1.4 *Red Oxide, Zinc Chromate Primer*

It consists of 16 parts of zinc chrome in combination with red oxide of iron and small proportion of suitable extender based on an oleo-resinous medium.

10.1.5 For specification of different primer paints, refer respective Indian Standard listed in Annex A

10.2 Finishing Paints

10.2.1 Aluminium paint conforming to IS 2339 is recommended mainly for its reflective value.

10.2.2 Synthetic enamel conforming to IS 2932 in long oil alkyed medium is an acceptable alternative.

11 APPLICATION OF PAINT

The performance of any painting system is strongly influenced by the manner and circumstances in which it is applied. Important factors include programme, correct storage of paint and its preparation for immediate use, the ambient conditions at the time of painting, the preparation of the surface for painting, the method of applying the paint and the standard of workmanship.

11.1 It is difficult to apply paint satisfactorily outdoors in bad weather, therefore if site painting is contemplated, it is wise to study the local meteorological data and chose the periods when the best weather conditions are to be expected.

11.2 Painting is skilled work, which should generally be done under competent and qualified supervision.

11.3 The common methods of applying paint are by brush, rolling, air pressure spraying, airless spraying and dipping.

ANNEX A

(*Clauses* 9.1.1, 9.1.2 *and* 10.1.5)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1303 : 1983	Glossary of terms relating to paints
1874 : 1992	Specification for ready mixed paints, universal zinc chrome, priming (synthetic) for light alloys for aircrafts
2074 : 1992	Specification for ready mixed paint, red oxide zinc chrome, priming
2339 : 1963	Specification for aluminium paint for general purposes, in dual container
2629 : 1985	Recommended practice for hot-dip galvanizing of iron and steel
2633 : 1986	Method for testing uniformity of coating on zinc coated articles
2932 : 2003	Specification for enamel, synthetic, exterior, type 1, (a) undercoating, (b) finishing, colour as required
3531 : 1997	Glossary of terms relating to protection of metals
4736 : 1986	Hot-dip zinc coating on mild steel tubes
4759 : 1996	Hot-dip zinc coatings on structural steel and other allied products — Specification
5905 : 1989	Sprayed aluminium and zinc coatings on iron and steel
6005 : 1998	Code of practice for phosphating of iron and steel
6586 : 1989	Recommended practice for metal spraying for protection of iron and steel
6743 : 1972	Determination of mass of zinc coating on zinc coated iron and steel articles
8508 : 1988	Recommended practice for hot-dip aluminizing of iron and steel.
8629 : 1977	Code of practice for protection of iron and steel structure from atmospheric corrosion
5228 : 2017	Continuous movement monocable ropeways with fixed grips — Code of practice
5229 : 2017	Continuous movement monocable ropeways with automatic grip — Code of practice
7649 : 1975	Glossary of terms used in connection with aerial ropeways and cableways
5230 : 2017	To and fro (jig back) movement bi-cable ropeways — Code of practice
16620 : 2017	Jig back movement monocable ropeways with fixed grips — Code of practice
16623 : 2017	Pulsated movement monocable ropeways with fixed grip — Code of practice

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Composition of the Panel-1 on 'Aerial Ropeways' MED 06

Organizations	*Representative(s)*
In Personal Capacity	Shri A. Bhadra (***Convener***)
In Personal Capacity	Shri C. K. Karmakar
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CRS, Pvt Ltd, Kolkata	Shri K. Bose
Damodar Ropeways & Infra Ltd, Kolkata	Shri Ranjan Mukherjee
Usha Breco Limited, Ghaziabad	Shri Manoj Panwar

Member Secretary

Shri A. K. Mohindroo
Scientist 'C' (MED), BIS

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Amendments Issued Since Publication

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